



## Nestbox sharing of the edible dormouse (*Glis glis*) during the active season

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### Abstract

*Glis glis* is known to use nest boxes to sleep during the day as well as for raising offspring. Whereas edible dormice prefer sleeping alone, many individuals of the observed population shared their nest sites with one or more other individuals at least once during the active season, i.e. from spring to autumn. In a sample area 65 km northeast of Frankfurt, Germany, all edible dormice captured were marked with passive transponders and daily nest box checks were carried out since 2002. In the present study we compare a year when dormice nearly skipped reproduction (2003) with a year when a high reproduction rate could be reported (2004). Our results reveal that edible dormice do have preferences with whom they share their nest during day sleep. These preferences are dependent not only on age and sex but also on the activity period and differ between reproductive and non-reproductive years.

**Keywords:** Individual marking, communal nesting, pair combinations, reproductive year

### 1. Introduction

The edible dormouse *Glis glis* is known to use nest boxes to sleep during the day as well as for raising offspring. While checking nest boxes, they are often found in pairs or –more rarely– in larger groups of up to 13 individuals, a fact which has already been described e.g. by Vietinghoff-Riesch (1960), Koenig (1960) and Pilastro (1992). Edible dormice reproduce preferably in years with high food availability and may skip reproduction in years when tree seeds, a major food resource, are absent (Bieber 1998, Ruf et al. 2006, Lebl. et al. 2011). Whereas mostly adult dormice reproduce, even subadults have been observed to be already sexually mature (Bieber 1998). While Hönel (1991) describes sleeping groups being formed by accident, Fietz et al. (2010) assume physiological reasons for especially sexual active adult males huddling together, using social thermoregulation to save energy. Ściński & Borowski (2008) as well observed male adult dormice sharing nest boxes and assume territorial factors for sharing nests. They could prove that the home range size of adult male dormice depends on sexual activity: in years when reproduction takes place, home ranges are larger but core areas would overlap more, which leads to an increased sharing of nests. Pilastro (1992) discussed the possibilities, that communal nesting could be a strategy to improve protection from predators or an unintended adjustment to a limited number of breeding holes, but assumed –especially for female dormice– social factors like kin selection for communal nesting. In fact, he found in his study area several closely related females sharing nest boxes (Pilastro et al. 1996). The present study focuses on the variability of age and sex in sleeping groups and tries to give an answer to the questions if these sleeping groups come together by coincidence and –if not– if these compositions change in relation to whether dormice engage in reproduction or not.

## 2. Material and methods

The data used for this study were obtained from a mark and recapture project monitoring the population biology of the edible dormouse near the town of Steinau an der Straße (50°20' N, 9°30' O), 65 km north-east of Frankfurt am Main, Germany. The sample area comprises 94 nest boxes installed on a 25 × 25 m grid of 5.6 ha. The study area contains mixed deciduous woodland of approx. 120 years old with oak *Quercus robur*, common beech *Fagus sylvatica* as well as hornbeam *Carpinus betulus* and a well developed shrub layer. From 2002 to 2008 once a week all dormice found in nest boxes were captured and marked with passive transponders and monitored from April to late autumn by carrying out daily checks using a scanner to minimize disturbance. For the present study we chose data from 2003, a year with low or nearly no reproduction, and 2004 which had a high reproduction rate.

We distinguished between juveniles that were born in the respective year, subadults that had overwintered only once and adults that had overwintered at least twice. Adults and subadults were differentiated by their body size and the colour of their fur according to Schlund (1997). For this study we only considered juveniles already independent from their mother i.e. when they have been at least found once without the adult female that we considered to be their mother. To answer the question if there are preferences or rejections of certain combinations of sex and age, we analyzed all theoretically possible pair combinations we could find in the detected sleeping groups.

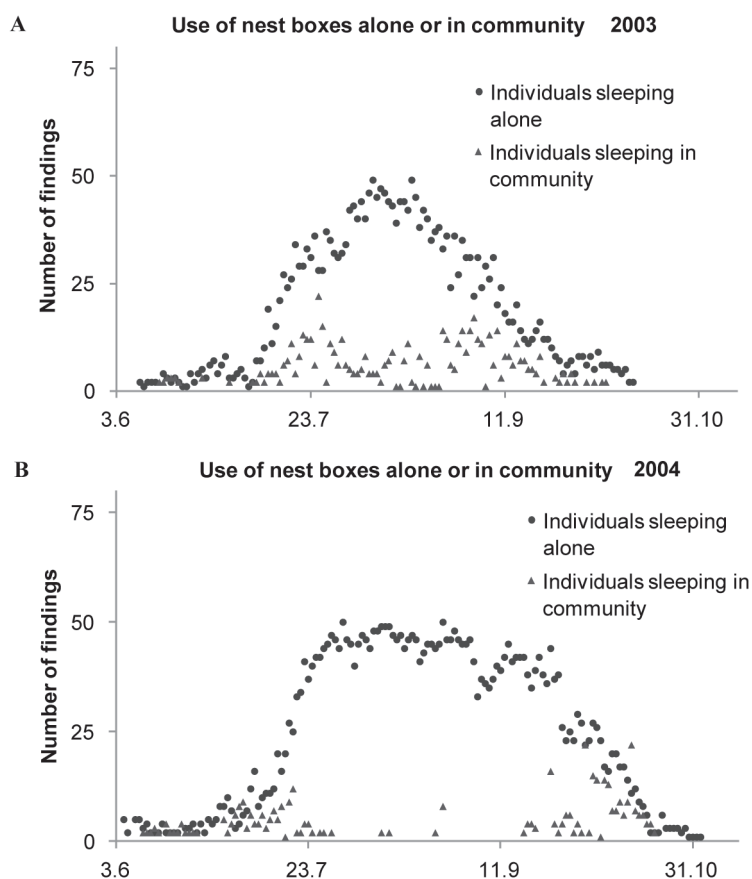
The numbers of pair combinations of different age and sex classes in both years were compared applying the Chi<sup>2</sup>-test. Due to the fact that we did not consider single individuals but various combinations of animals of the same population, results of these statistics could be biased.

## 3. Results

Dormice were found sleeping alone more often than in pairs or groups (2003: Chi<sup>2</sup> = 1749.915, df = 1, p < 0.001; 2004: Chi<sup>2</sup> = 3179.731, df = 1, p < 0.001). Checking nest boxes in 2003 we found dormice sleeping alone in 2497 cases whereas in 289 cases we found a pair or a group of animals. In 2004 we recorded animals sleeping alone 3747 times and in 203 cases a pair or a group huddling together (Figs 1A, B)

The graphs show the number of individuals using nest boxes communally or alone for every day during the activity seasons of 2003 and 2004. In 2003, when nearly no reproduction was observed, the dormice shared nest boxes throughout the complete active season. In 2004 nest sharing dormice were found from their emergence from hibernation until the end of July –presumably the mating season– and again before hibernation in September and October. Only sporadically we found *Glis glis* sharing a nest box between the end of July and the middle of September, regardless of being involved in raising offspring or not.

In 2003 we found a total of 141, in 2004 183 individuals of edible dormice. In the reproductive year 2004 the majority of individuals would sleep in pairs or groups at least once during their activity period (Chi<sup>2</sup> = 12.071, df = 1, p = 0.001), whereas in 2003 no significant difference could be observed (Chi<sup>2</sup> = 3.128, df = 1, p = 0.077). In 2003 81 animals were found 637 times nesting together while in 2004 115 animals were found only 434 times in shared nests. Table 1 shows that in 2003 50% and in 2004 57% of all adult females recorded in our study area were found at least once in shared nests. In 2003, 45.7% of all adult males shared nests while in the reproductive year 2004 only 29.5% of them could be detected in a sleeping group.

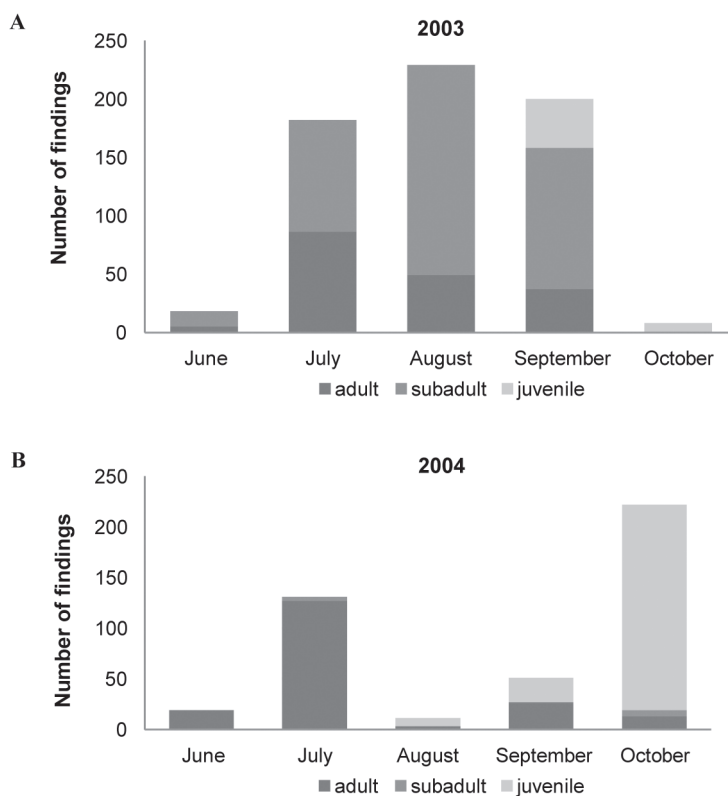


**Fig. 1** Numbers of individuals sleeping alone in a nest box as well as those sharing nests with other dormice during the activity period in 2003 (a non-reproductive year) and 2004 (a reproductive year) based on daily nest box checks.

**Tab. 1** Edible dormice sharing nest-sites in 2003 and 2004. A = Total number of animals. B = Number of animals sharing their nest at least once. C = Number of records of animals in pairs or groups.

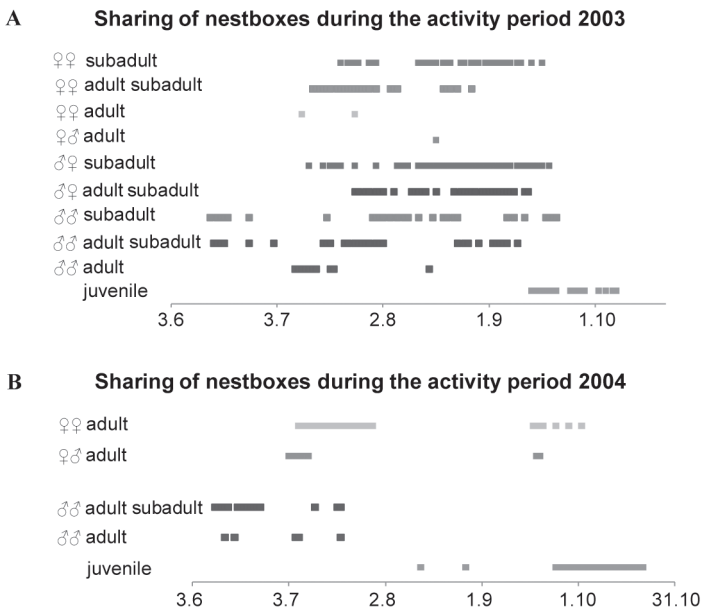
	2003				2004			
	A	B	%	C	A	B	%	C
♂ adult	35	16	45.71	109	44	13	29.55	47
♀ adult	32	16	50.00	68	46	26	56.52	135
♂ subadult	27	17	62.96	160	3	2	66.67	19
♀ subadult	31	21	67.74	250	2	1	50	5
♂ juvenile	11	8	72.73	31	51	43	84.31	145
♀ juvenile	5	3	60	19	37	30	81.08	90
results	141	81	57.54	637	183	115	62.84	434

Figures 2A and 2B demonstrate that the decision to sleep in groups or alone is dependent on whether the dormice go into reproduction or not and on the course of the active season. In 2003 the first dormouse of the season was reported in the middle of June. On the 15<sup>th</sup> of June the first adult male and on the 10<sup>th</sup> of July the first adult female emerged from hibernation. In the reproductive year 2004 the activity season started slightly earlier. The first adult male was recorded on the 5<sup>th</sup> of June and the first adult female on the 27<sup>th</sup> of June. The low number of sleeping groups in June can be explained by the low presence of active dormice. In both years sleeping groups were dominated by either subadult or juvenile dormice. While in 2003, between June and September, mainly subadult dormice shared their nest sites there were increasing numbers of juveniles forming groups to sleep together after separation from their mother from August to October in the reproductive year 2004. In both years, and especially in 2004, we found adult dormice sharing their nests particularly in July whereas in August, when population density is at its highest (see Figs 1A and 1B), the number of recorded nest sharing by adult dormice declined. In spite of this, in 2003 subadult dormice were recorded to be involved in sleeping groups particularly in August.



**Fig. 2** Records of dormice (*Glis glis*) of different ages and sexes sharing nest sites during the active season in a non-reproductive year (2003) and a reproductive year (2004).

Figures 3A and 3B show various combinations of age and sex found during the active season from the beginning of June to October in the years 2003 and 2004. In 2004, only very few of the combinations found in 2003 could be detected due to the low numbers of subadult dormice. At the beginning of the active seasons in both years only male edible dormice were found sharing nest boxes due to the later emergence from hibernation of females. In both years adult males were found together with other adult males only until the middle of July (except one record in August 2003). While in 2003 male dormice accepted subadult males as sleeping partners throughout the whole active season, they could not be found together after the middle of July –presumably after the mating period– in the reproductive year 2004. In 2003 adult females are only sporadically found with other adult animals but in 2004 in July and from the middle of September –presumably after the dispersal of the offspring– adult females were found together in sleeping communities. During short periods in July and in September we found adult females sharing their nest box with adult males. From mid-September in both years, there were several groups consisting only of juveniles where we disregarded sex.



**Fig. 3** Various combinations of age and sex in sleeping groups during activity period in non-reproductive (2003) and a reproductive (2004) year based on daily nest box checks.

Table 2 shows how often the various combinations of sex and age could be detected in 2003 and 2004. In the year where nearly no litters were born, we recorded a great variety of combinations, especially with subadult dormice (329 findings), throughout the active season. Particularly combinations of subadult males with subadult females but as well combinations of two or more subadult males together or subadult females together could be detected. In the non-reproductive year 2003 adult dormice were mainly found in various combinations with subadult dormice, especially with subadult females. Subadult females were significantly more often found with adult females ( $\chi^2 = 33.618$ ,  $df = 1$ ,  $p < 0.001$ ) and adult males

( $\chi^2 = 8.010$ ,  $df = 1$ ,  $p = 0.005$ ) than we could find subadult males with adult animals. In only 11 cases we could find adult animals together sharing nest sites. While adult males could be found 10 times together with other adult males, combinations of adult females could be detected 7 times. Only sporadically we found adult females sharing a nest box with adult males.

In the reproductive year 2004 we detected more combinations among adult dormice than in 2003 ( $\chi^2 = 33.242$ ,  $df = 1$ ,  $p < 0.001$ ), especially adult females were found very often in sleeping groups. In 2004 adult females were more often found together with other adult females ( $\chi^2 = 27.769$ ,  $df = 1$ ,  $p < 0.001$ ) and with adult males ( $\chi^2 = 17.190$ ;  $df = 1$ ;  $p < 0.001$ ) than in 2003. There were no significant differences between 2003 and 2004 in the number of records of adult males huddling together ( $\chi^2 = 0.222$ ,  $df = 1$ ,  $p = 0.637$ ). Adult females are found more often huddling together than adult males ( $\chi^2 = 25.830$ ,  $df = 1$ ,  $p < 0.001$ ). Due to the low reproduction rate in 2003 only few combinations with subadult dormice were found in 2004. While adult females could be detected sharing nests with subadult males only sporadically, adult males were found 17 times sleeping in one nest box with subadult males. There were nearly no combinations with subadult females found in 2004. We could not detect any nest sharing between adult and subadult females and only one single record of an adult male sleeping in a nest box with a subadult female. After separation from the juvenile dormice, adult females were more frequently found together with juvenile females than with juvenile males ( $\chi^2 = 4.455$ ,  $df = 1$ ,  $p = 0.035$ ).

**Tab. 2** Various combinations of nest sharing dormice found in 2003 and 2004. A: Number of records. B: Percentage of all combinations detected in the actual year.

Combination	2003		2004	
	A	B	A	B
♀♀ adult	7	1.9	45	18.91
♂♂ adult	10	2.71	8	3.36
♀♂ adult	1	0.27	20	8.4
♀♀ adult subadult	49	13.28	0	0
♂♂ adult subadult	38	10.3	17	7.14
♀♂ adult subadult	6	1.63	1	0.42
♂♀ adult subadult	67	18.16	1	0.42
♀♀ adult juvenile	1	0.27	29	12.18
♀♂ adult juvenile	4	1.08	15	6.3
♂♂ adult juvenile	0	0	10	4.2
♂♀ adult juvenile	0	0	5	2.1
♀♀ subadult	51	13.82	0	0
♀♂ subadult	80	21.68	0	0
♂♂ subadult	31	8.4	0	0
♀♀ subadult juvenile	1	0.27	0	0
♂♂ subadult juvenile	1	0.27	0	0
♀♂ subadult juvenile	5	1.36	0	0
♂♀ subadult juvenile	0	0	0	0
♀♀ juvenile	0	0	16	6.72
♂♂ juvenile	2	0.54	47	19.75
♀♂ juvenile	15	4.07	24	10.08

#### 4. Discussion

Looking at 2003 and 2004 we found enormous differences between the two years. First, the period in which nest sharing takes place differs between these two years. In 2003 – which was a low reproductive year – nest sharing occurred throughout the whole activity period, while in 2004 nests were only shared before and after the breeding period. Ruch (2009) assumed a generally low willingness to share nests in reproductive years due to territorial behaviour. For adult male dormice we could confirm this. While in 2003 45.7% of all male adults were found at least once sleeping in pairs or groups, in 2004 only 29.6% of all adult males shared their nest sites. In spite of this, the percentage of all dormice present, especially adult females, sharing their nests at least once would not decline but slightly increase from 57.5% in 2003 to 62.4% in the reproductive year 2004. Fewer records of huddling dormice in 2004 could be explained by the absence of subadults due to the low reproduction rate in 2003. The differences in the nest sharing rates can be explained by the varying time pattern of nest box sharing in both years.

Sleeping groups of dormice seem to be more stable and last longer in non-reproductive years such as 2003. Fietz et al. (2010) assumed that there are energetic reasons for male edible dormice to share nests in reproductive years due to the high energy costs caused by a high testosterone level during the mating season. Although our data do not show any increased occurrence of adult males sharing nest sites in reproductive years, forming sleeping groups as a strategy to save energy would explain the high affinity of juveniles and subadults to huddle together. Small dormice might form groups to save energy because of their higher surface area to volume ratio and therefore a higher proportional heat loss across their body (Heldmaier & Neuweiler 2004). Adult females especially should have a severe loss of energy caused by gestation and lactation. In fact, they do significantly more often share nests with other females in reproductive years, especially during the mating season and after the breeding period when they are in a physiologically poor condition. The absence of any sleeping groups from the end of July to the middle of September could, for adult females, be due to raising their offspring which prevents them from using social thermoregulatory mechanisms during the time when energy loss is at its highest. Due to the fact that reproduction in *Glis glis* only takes place in years with high food availability (e.g. Bieber 1998, Ruf et al. 2006, Lebl et al. 2011) the energy level for all other dormice might be high enough to avoid the need for nest sharing during the hot summer months. Fietz et al. (2010) proved a negative correlation between surrounding temperatures and the numbers of huddling dormice. Besides the saving of energy, sleeping in groups might be a hint at the presence of a social system within a dormouse population. We found fewer male dormice sharing nests in the reproductive year in general, but the number of findings with adult females in July increased significantly, which we suggest to be part of the mating system. Social aspects, possibly even kin selection, could as well be responsible for the high number of adult females sleeping together and the fact that juvenile females stay significantly more often with adult female dormice. Pilastro et al. (1996) found in their study area several females nesting and even nursing communally and proved them to be close relatives particularly mother-and-daughter-pairs. These significant preferences in sleeping partners in both years indicate that sleeping groups do not come together by coincidence but, rather, are underlain by several physiological, hormonal and social aspects that differ within the activity period and years with and without reproduction.

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Accepted 9 August 2012

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Band/Volume: [8](#)

Autor(en)/Author(s): Koppmann-Rumpf Bettina, Scherbaum-Herberer Carina, Schmidt Karl-Heinz

Artikel/Article: [Nestbox sharing of the edible dormouse \(\*Glis glis\*\) during the active season 189-196](#)